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WaveNet: A Web-Based Metocean Data Access, Processing, and Analysis Tool; Part 3 – CDIP Database

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PURPOSE: This Coastal and Hydraulics Engineering Technical Note (CHETN) describes coupling of the Coastal Data Information Program (CDIP) database to WaveNet, the first module of MetOcnDat (Meteorological and Oceanographic Data or Metocean data) management and analysis system. This Part 3 in the WaveNet technical note series is a user's guide that provides a step-by-step procedure to access, process, and analyze wave and wind data from the CDIP database.

BACKGROUND: WaveNet addresses a basic need of the Corps coastal modeling and planning missions by acquiring metocean data and providing a tool to minimize the complexity and uncertainty involved in data processing. This web-based, Graphical-User-Interface (GUI) data management tool allows the user to access, process, and analyze wave and wind data from different metocean data sources. This tool allows the user to perform data processing to check availability, quality, and consistency of data; extract, download, analyze, and prepare input files for numerical wave models; and provide tabular and graphical information for analysis, project planning, and reporting. Part 1 (Wilson et al. 2012) and Part 2 (Demirbilek et al. 2013) are companion CHETNs in this series that provide a detailed description of WaveNet and demonstrate the coupling of WaveNet with the National Data Buoy Center (NDBC) and Wave Information System (WIS) databases, respectively. WaveNet provides a unified platform to perform these functions in a consistent manner to avoid potential errors and has additional custom analysis tools that may not be available from data sources. This user's guide includes step-by-step instructions for accessing the CDIP database using WaveNet and one example application that illustrates processing and analysis of CDIP data for project planning, design and evaluation studies, and generation of input files for numerical wave models.

WaveNet uses a Google Map® interface to query, select, and display a particular set of data parameters from a preferred data source of a map region. The user selects the date range to query the availability of data; plot, analyze and extract data; post-process to produce tabular data and plots in a desired format; and write input files for numerical models. WaveNet helps the user to obtain statistical wave parameters such as significant wave height, peak period and direction, and generates wave and wind roses and histograms of directional wave data for project needs. Types of outputs available in WaveNet are image files (*.png), portable document files (*.pdf), Matlab figures (*.fig), text files (*.csv or *.txt), and spectral input files (*.eng) for numerical models. The user can modify the figures to view data plots and change axes and labels or text for project reports and other publications as necessary. The *.eng is an input file in the format required by numerical wave models CMS-Wave (Demirbilek and Rosati 2011; Lin et al. 2011a, b; Lin et al. 2008) and STWAVE (Massey et al. 2011).

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The following example illustrates in a step-by-step manner the use of WaveNet with the CDIP data and includes comments and instructions to guide the user, where deemed necessary.

EXAMPLE: CDIP Data for California Coast

This project assumes that the following wave and wind data are needed for 1 March 2001 through 28 December 2001 at a 1/2-hour interval: significant wave height, peak or mean wave period and mean direction in tabular form, wave and wind roses, and an *.eng file. This example shows how to use the WaveNet to access the CDIP database, fetch the data from the source, and provide the desired data in the format required for project-specific needs, including use in numerical wave models.

Step 1. Select the sub-region of interest. Click the following link to start the WaveNet server (*http://wavenet.usace.army.mil*) on a Corps network. Use the mouse to click and zoom into the region of interest where CDIP data are desired (Figure 1). Zoom into any part of the map, including Alaska and Hawaii.

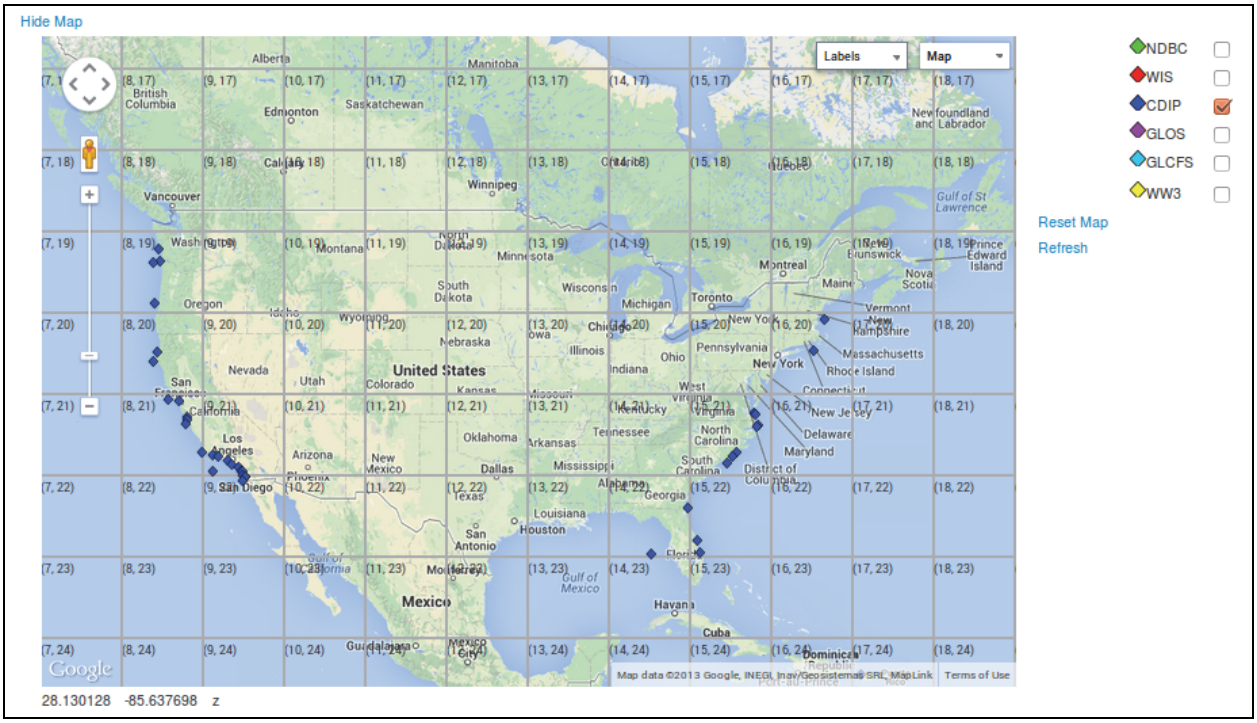

Figure 1. WaveNet main page for user to select the area of interest on a Google Map®.

Step 2. Select the data source and type of metocean data available from the CDIP database. The list of available data sources is shown in the right side of Figure 1 and includes the NDBC, WIS, CDIP, Wave Watch III (WW3), the Great Lakes Observing System (GLOS), and Great Lakes Coastal Forecasting System (GLCFS). Select CDIP as the data source. In this example, the area of interest is the California Coast. Select this area of interest by using the map tools and zooming in to this region (Figure 2).

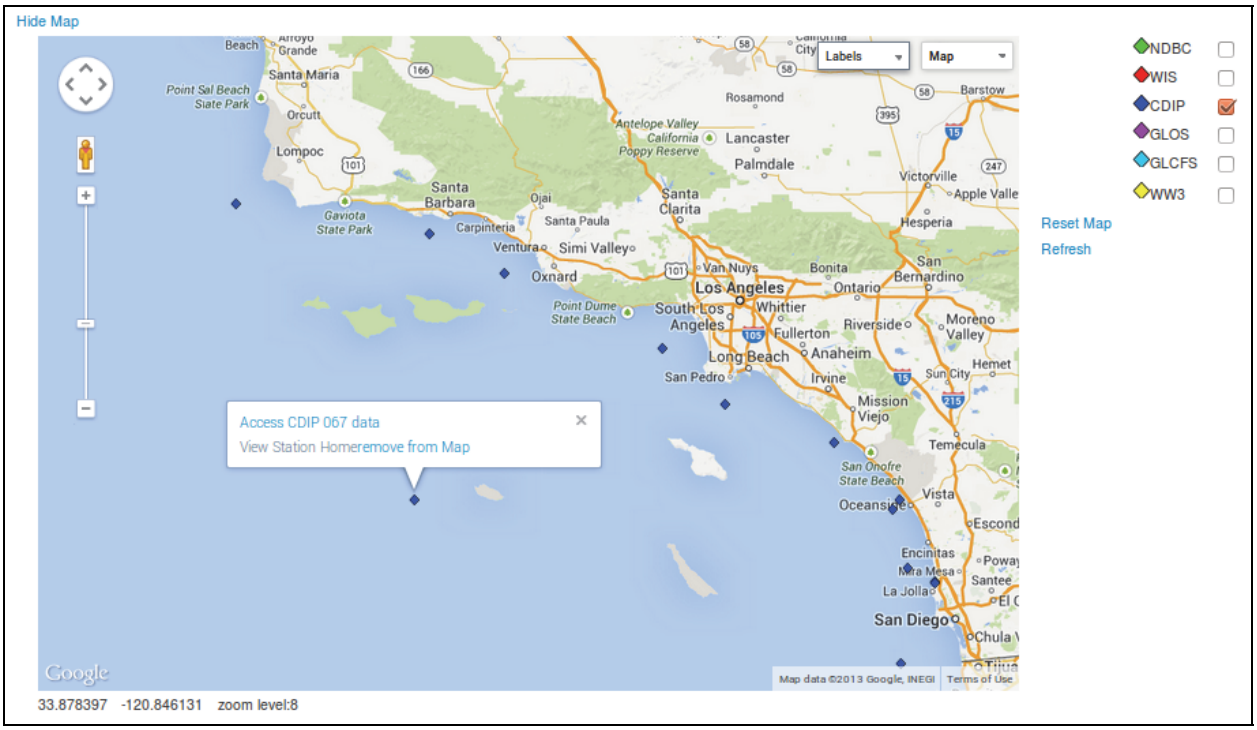

Figure 2. CDIP stations offshore of California.

Step 3. Select a CDIP station in the area of interest. To access the station-specific data available from the CDIP database, select a CDIP station amongst those displayed in Figure 2. For this example, select Station 067. Click on the **View Station Home** link to access the station's page on the CDIP website or the **Access Station 067 Data** window option to access the station's data within WaveNet. The type of station-specific data available at CDIP 067 is shown in Figure 3. Click on any of these data types to view data, plots, and tables provided by the CDIP data source. See Figure 3 for available information.

Step 4. Set the time range to determine availability of data for project needs. In Figure 4, time series of the significant wave height and wind speed at CDIP Station 067 are displayed for a user-specified time period (1 Mar 2001 through 28 Dec 2001). Access the data available at Station 067 with WaveNet by specifying a time window of interest and clicking **Retrieve/Plot Data**, which is located above the timeline plot shown in Figure 4. There is a *slider bar* at the bottom of the plot for changing the start and end times, or manually type in the desired dates. To narrow the time window of interest to specific days or months, use the slider bar at the bottom of the plot or click on the display box. Two options are available to change dates: type in the **start** and **end** date boxes or use the calendar (Figure 4). The timeline plot will show data availability for wave height and wind speed, including the data gaps.

Step 5. Download data for project needs. To perform additional analyses of data, download data from the CDIP data source for the date range chosen. Click on **Download** to save data in a *.csv file (Figure 4). The csv is an ASCII spreadsheet with comma-separated values in text format. Table 1 displays the partially tabulated *.csv data saved by WaveNet and displayed in commercial tabular software. These ASCII data can be used with the Matlab, Fortran, Excel or other software or commercial plotting packages, if desired.

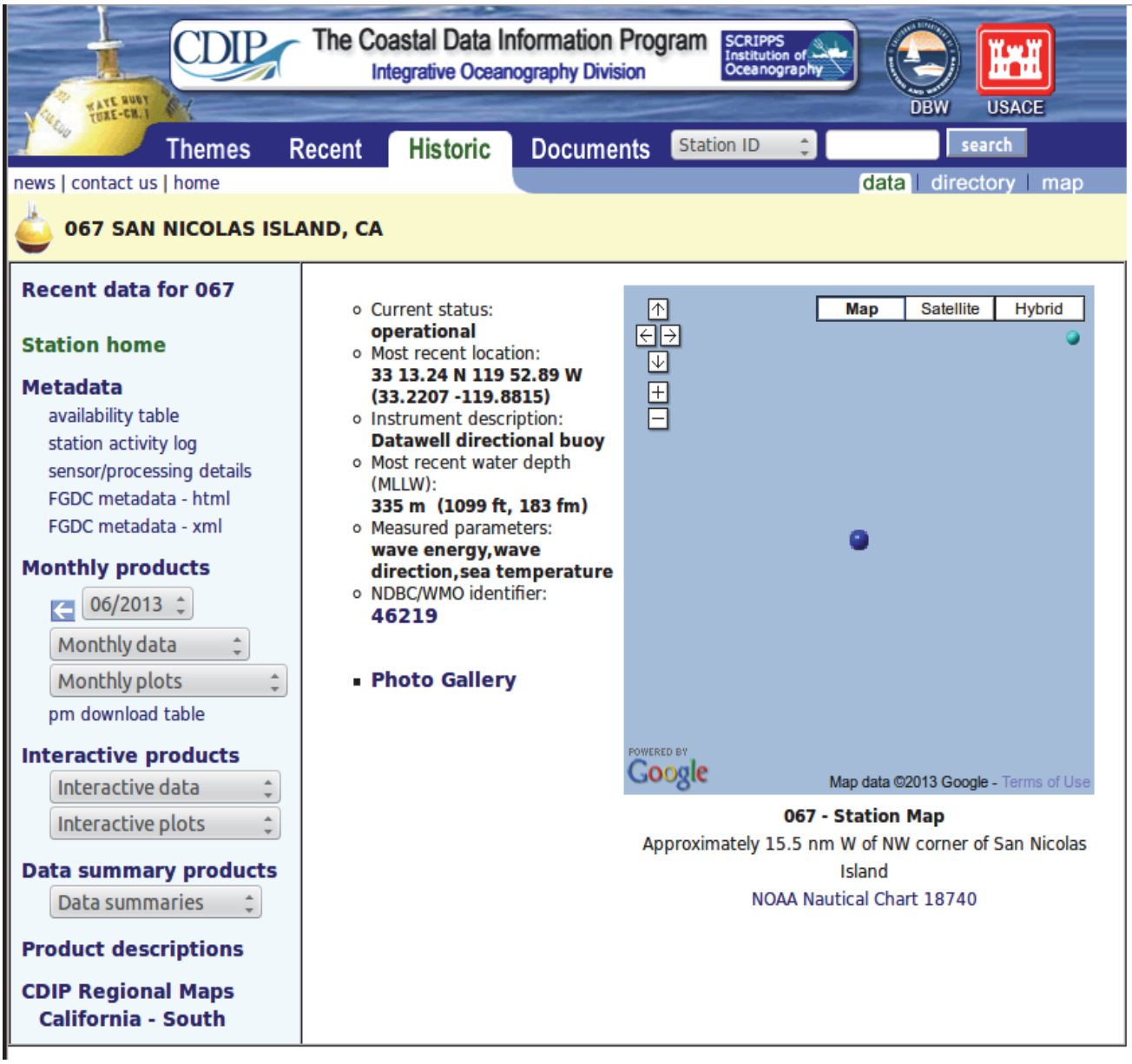

Figure 3. CDIP Station 067 web page: a location off the California Coast.

Step 6. Generate wave, wind roses, and histograms. These processing tools are available in WaveNet. If a data source does not provide rose plots or histograms, generate such plots for wave or wind for the downloaded data by clicking on **Roses/Histograms** below the timeline plot (as shown at the bottom of Figure 4). Note with caution that not all CDIP stations have wind data, and Station 067 does not. A rose plot is generated for directional wave data as shown in Figure 5. In wave roses, the percent occurrence is depicted by radial circles, and the 1-meter (m) wave height bands are color coded in the radial direction. If the CDIP station had wind data, a similar rose plot for winds would have been generated. In these types of plots, the direction bins from which waves and winds approach the shore are shown in color-filled arrows. Figure 6 shows the wave histogram that illustrates the statistical distribution of wave height.

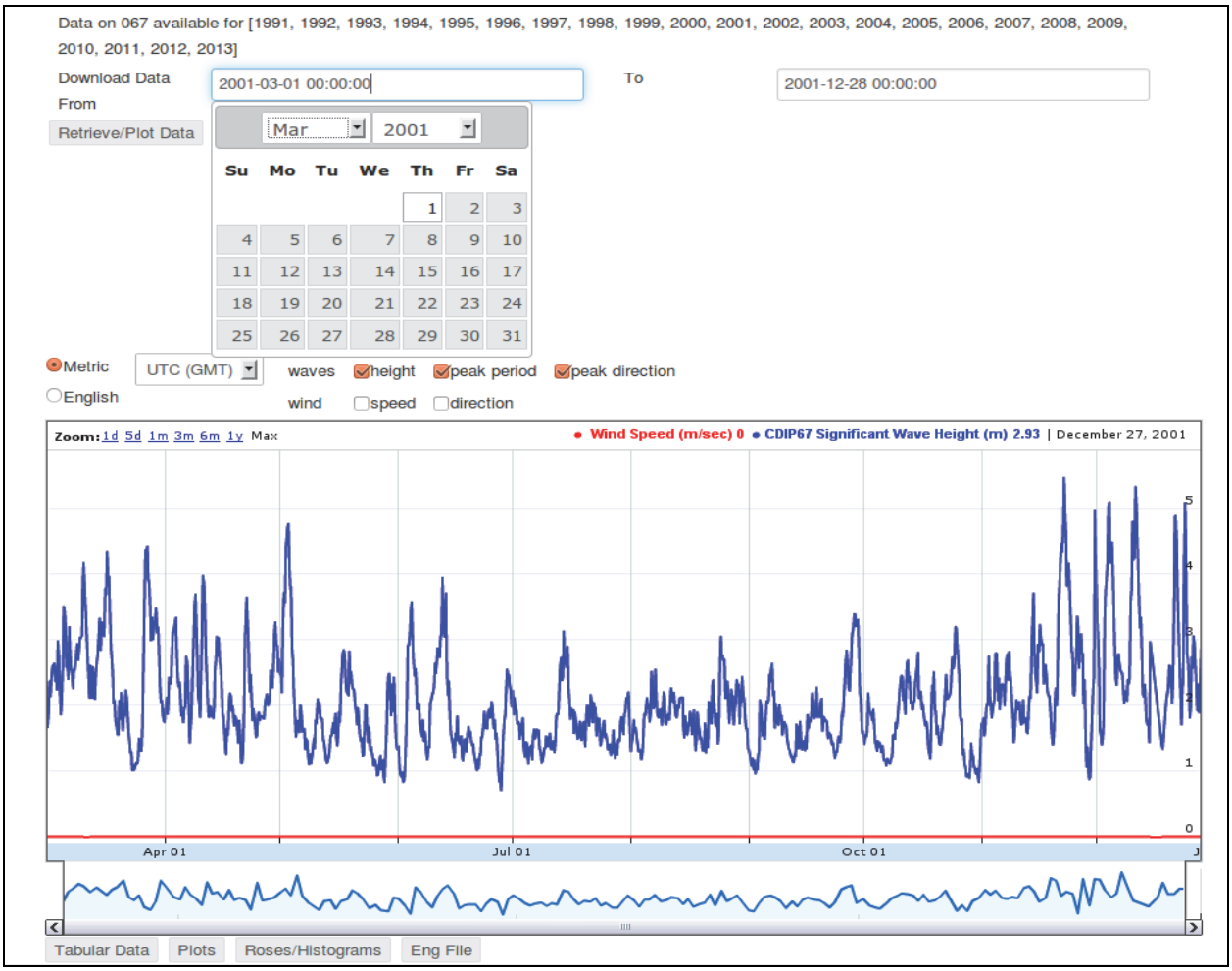

Figure 4. Time series of significant wave height, with time window customized by user.

Table 1. Tabulated data downloaded to local machine for CDIP Station 067.

	A	B	C	D	E	F	G	H	I
1	yyyy	mm	dd	hh	min	WaveHt	PeakPer	MeanPer	PeakDir
2						m	sec	sec	deg
3	2001	3	1	0	13	1.67	18.2	8.1	290
4	2001	3	1	0	43	1.77	12.5	8.1	288
5	2001	3	1	1	13	1.8	16.7	8.4	292
6	2001	3	1	1	43	1.61	18.2	8.3	280
7	2001	3	1	2	13	1.65	18.2	8.3	294
8	2001	3	1	2	43	1.74	16.7	8.9	295
9	2001	3	1	3	13	1.76	18.2	9	294
10	2001	3	1	3	43	1.8	18.2	9	292
11	2001	3	1	4	13	1.83	18.2	8.6	294
12	2001	3	1	4	43	1.81	16.7	8.6	297
13	2001	3	1	5	13	1.91	16.7	9.4	292
14	2001	3	1	5	43	1.9	18.2	9	290
15	2001	3	1	6	13	1.8	18.2	8.7	288
16	2001	3	1	6	43	1.78	16.7	9	299
17	2001	3	1	7	13	1.87	18.2	9.2	298
18	2001	3	1	7	43	2	16.7	9.7	297
19	2001	3	1	8	13	1.85	18.2	9.3	285
20	2001	3	1	8	43	2.08	16.7	9.9	297

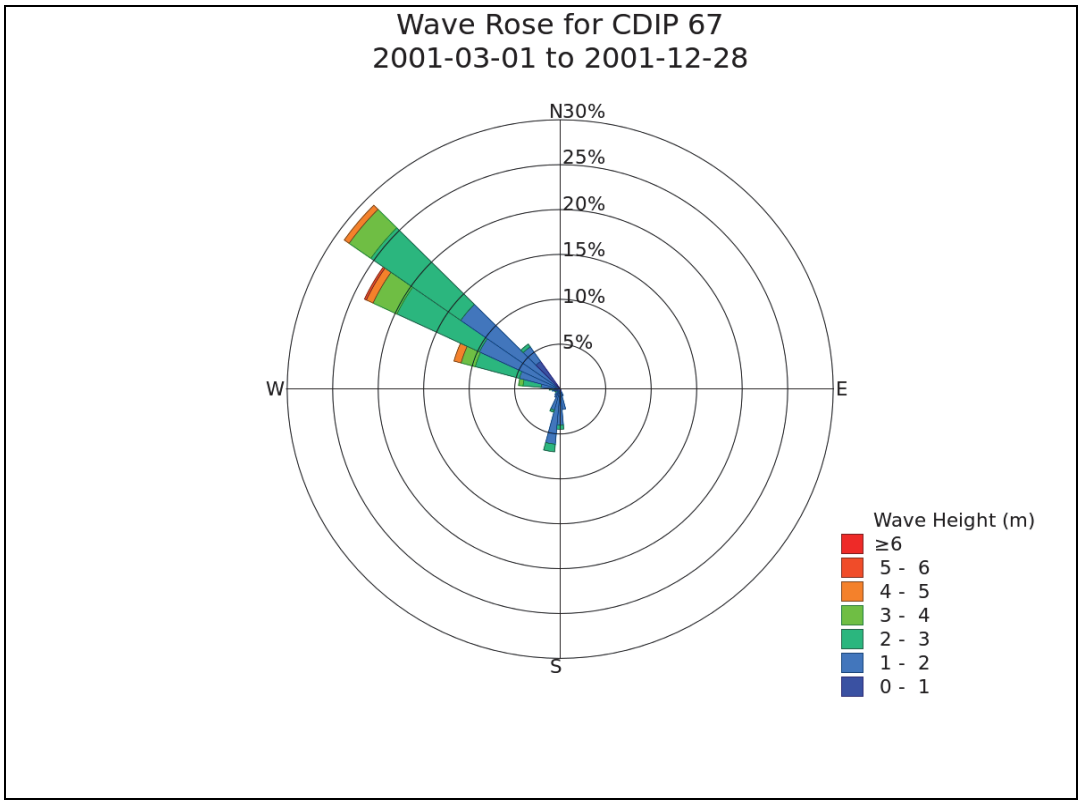

Figure 5. Rose plot for waves at CDIP Station 067.

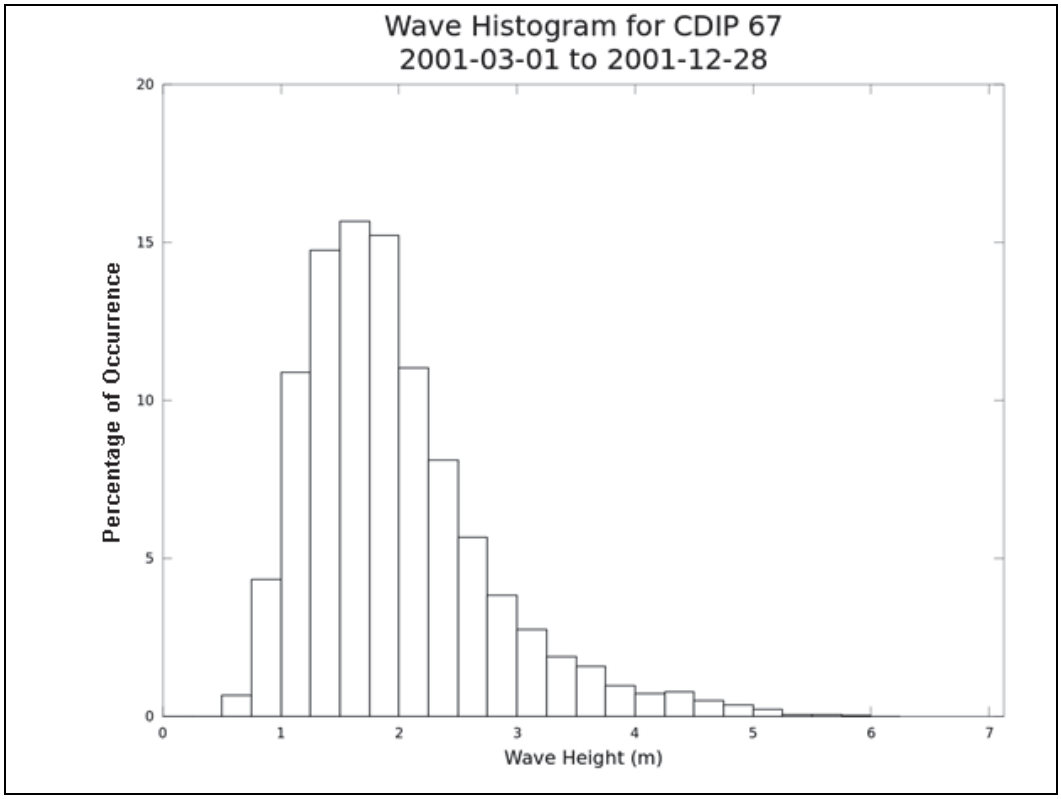

Figure 6. Histogram for waves at CDIP Station 067.

Step 7. Analyze desktop data. After the segments of data have been accessed from the CDIP database, reviewed, and downloaded using WaveNet, then perform certain data analyses. For example, the CMS-Wave and STWAVE models require an *.eng file for spectral wave input. If directional wave data (1D or 2D wave spectra and associated Fourier coefficients used to generate wave spectra) are available from the data source, download these files and perform post-processing analyses for project-specific needs. If Fourier coefficients are not provided by the data sources, generate a *.eng file from wave spectra or parameters by using WaveNet. By default, the *.eng file will be generated at the water depth of the data source station. To generate an *.eng file for a numerical model, specify the grid orientation and depth at the wave model grid incident boundary, and then click on the **Eng File** (located below the timeline plot in Figure 7). Based on the timeline selected, one or multiple *.eng files can be generated and listed at the bottom of Figure 7. Detailed information about the *.eng files can be found in Lin et al. (2008, 2011a, b). For illustration, Table 2 displays the partial content of a sample *.eng file.

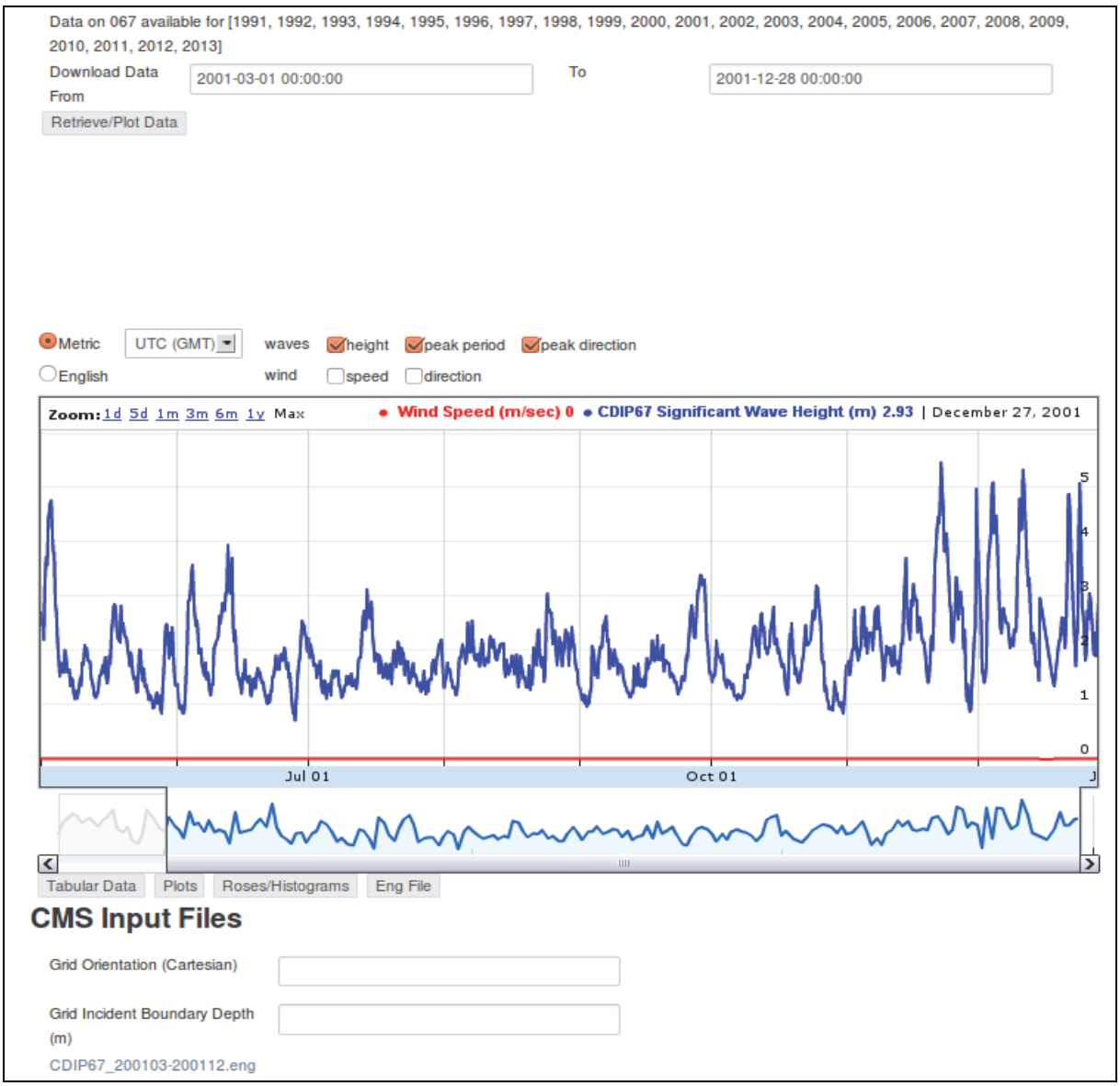

Figure 7. One *.eng input file generated by WaveNet for CDIP Station 067.

Table 2. Partial content of a sample *.eng wave input file generated by WaveNet.

```
30 35
0.04000 0.05000 0.06000 0.07000 0.08000 0.09000 0.10000 0.11000 0.12000 0.13000
0.14000 0.15000 0.16000 0.17000 0.18000 0.19000 0.20000 0.21000 0.22000 0.23000
0.24000 0.25000 0.26000 0.27000 0.28000 0.29000 0.30000 0.31000 0.32000 0.33000
9040821     9.1       -42.    0.30000    0.00
   0.00032    0.00033    0.00034    0.00034    0.00034    0.00033    0.00032
   0.00030    0.00029    0.00026    0.00024    0.00021    0.00018    0.00015
   0.00013    0.00010    0.00007    0.00005    0.00003    0.00001    0.00000
   0.00001    0.00005    0.00010    0.00017    0.00025    0.00033    0.00043
   0.00052    0.00062    0.00071    0.00081    0.00089    0.00097    0.00103
   0.00108    0.00112    0.00114    0.00115    0.00114    0.00112    0.00108
   0.00103    0.00097    0.00089    0.00081    0.00071    0.00062    0.00052
   0.00043    0.00033    0.00025    0.00017    0.00010    0.00005    0.00001
   0.00005    0.00017    0.00034    0.00056    0.00082    0.00111    0.00142
```

CONCLUSIONS: The Part 1 and Part 2 companion CHETNs have respectively described how to use WaveNet tools and analysis capabilities for NDBC and WIS data sources. This Part 3 note demonstrates the coupling of WaveNet with the CDIP database in order to enhance the capabilities of WaveNet for Districts to obtain project-specific data from CDIP stations. The coupling of WaveNet to the CDIP database is illustrated through an example application for the CDIP Station 067. A step-by-step procedure is provided to show how to use WaveNet to access wave and wind data from the CDIP website and extract and analyze CDIP data for coastal navigation and storm damage reduction projects. Note that not all CDIP stations have wind data. This user guide for engineers and planners helps to obtain observed wave data for project planning, design and evaluation study reports, and to develop input files for numerical wave models such as CMS-Wave and STWAVE. Like other data sources, the CDIP data also vary in content, complexity, and accuracy of information. User feedback is welcome from the USACE community for expanding and improving the capabilities of WaveNet for project applications.

POINTS OF CONTACT: This CHETN was prepared by the Coastal Inlets Research Program (CIRP) Waves work unit. The POC for technical inquiries is Zeki Demirbilek (*Zeki.Demirbilek@usace.army.mil*). For information about CIRP, contact the CIRP Program Manager, Julie Dean Rosati (*Julie.D.Rosati@usace.army.mil*). This technical note should be referenced as follows:

> Demirbilek, Z., L. Lin, and D. Wilson. 2014. *WaveNet: A web-based metocean data access, processing, and analysis tool; part 3–CDIP database*. ERDC/CHL CHETN-IV-100. Vicksburg, MS: U.S. Army Engineer Research and Development Center. An electronic copy of this CHETN is available from *http://chl.erdc.usace.army.mil/chetn*.

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